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The New Bye-Laws

Members of the Institute of British Foundrymen are now in possession of the new Bye-Laws. The booklet containing these opens with the Charter of Incorporation, using, initially, the dignified phraseology of bygone ages. We have often wondered at the Privy Council's reference in the Charter to ". . . the name of the Institute of British Foundrymen (hereinafter referred to as the 'Institution') . . ."—though, in earlier times, we have fallen into the same error. However, in the supplemental charter of 1948, the Privy Council conforms with common usage and employs "The Institute." The outcome of the Supplemental Charter is the right which the members now have to use, after their names, letters indicative of membership of the Institute:—Hon. M.I.B.F.; M.I.B.F. and A.M.I.B.F. Then there has been a general tidying-up of the structure of the Institute by regularising the position of subscribing firms and by defining more clearly the qualifications for admission to the various grades of membership. The main factor, however, is the acceptance of an amended set of Bye-Laws.

These new Bye-Laws contain a number of interesting features. For instance, before a foreigner can be elected an honorary member, approval must first be obtained from the Privy Council. Moreover, the number of such honorary members is limited to five. One qualification for full membership is that a candidate must be 30 years old, and it is somewhat surprising that quite a few applicants fail to recognise this elementary fact. Recognition is given to "eminence in the foundry industry," and here the minimum age is 35. The qualifications for Associate Membership are governed by a combination of academic attainments, practical experience and age. The simplicity of the wording is admirable, and little trouble should be experienced in the future in the assessment of a candidate's application. Changes are now made in the composition of the Council of the Institute. Under the old bye-laws the membership of this body had become so large as to border on the unwieldy. Reduction is being effected by limiting the representation from the Branches to a maximum of four from any one of them. This means that London, Lancashire, Birmingham, East Midlands and Scotland have already attained the new maximum and most of these will be subject to cuts.

Bye-Laws never have been and never will be perfect. On the point of good English we object to the occasional appearance of "and/or." This phrase should find no place in the publications emanating from a Royal Chartered Institute. It may be good commercial "journalese," but it is certainly poor English. Beyond this mild criticism, we deem to the new Bye-Laws to be thoroughly workmanlike and conducive to the material well-being and continued progress of the Institute. It now remains for the individual member to recruit new adherents, well knowing that he has something concrete to offer. Much in the past was nebulous, as for instance the wisdom of using the membership letters after one's name, and the "chanciness" of the grade to which one would be allocated. Grading of the personnel within the foundries did not and does not always align itself with the qualifications required by the Institute, but there must be a general acceptance of the implication that the latter is actuated solely by technical considerations, whilst in the former, financial investment, commercial experience and a host of other factors operate. Excellent work has been done in the formulation of the Bye-Laws, and we congratulate the responsible committee upon the successful outcome of its work.

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Training Course for Foremen

The Council of the Institute of British Foundrymen is organising a training course for foremen, which will be held at Ashorne Hill, near Leamington Spa, Warwickshire, from Thursday, April 21, to Saturday, April 23, 1949. The provisional programme for the course is as follows:—

Thursday Evening, April 21: Assembly at Ashorne Hill.

Friday, April 22: Lectures on "Human Relations," "Incentive Systems—Standards of Work Performance," and "Overheads and Production Costs."

Saturday, April 23: Lectures on "Production Control" and "The Maintenance of Plant and Equipment."

The authors of the lectures forming the course have been selected with great care to ensure that the guidance given is authoritative, and the value of the course will be enhanced by the opportunities which will be provided for exchange of experience during discussion of the lectures and in personal contact with other visitors.

The number of vacancies for the course is strictly limited and they will be allocated in accordance with the order of receipt of applications. It should be noted that the course is intended for foremen in charge of men, and the lectures are designed to give this category of foundry executive practical guidance in the special problems arising in the discharge of their duties. All foundry managements are urged to encourage and facilitate the attendance of members of their staffs who come within this classification.

The charge for accommodation at Ashorne Hill is 30s. per day, which includes dinner, bed, breakfast, lunch, tea and a snack. Those attending the course who do not require sleeping accommodation at Ashorne Hill may obtain meals there at a charge of 10s. per day.

Forms of application to attend the course may be obtained from the Secretary, the Institute of British Foundrymen, St. John's Street Chambers, Deansgate, Manchester, 3. Forms should be completed and returned as soon as possible, and in any event not later than March 31, 1949.

For Youth in Industry

Sir William Garrett is now principal of a college established at Glyn House, Kingsgate, near Broadstairs. Here are held at regular intervals courses designed to enlighten young men in their early twenties as to the solution of the special current problems, examination of their history and appreciation of the place which industry occupies in the social and technical development of the community. The Industrial Management Bulletin No. 34, issued by the Council of Ironfoundry Associations, devotes considerable space to this new development, and the Secretary has available descriptive pamphlets covering this activity, which he will send to readers who are interested. The address is now Crusader House, 14, Pall Mall, London, S.W.1.

Forthcoming Events

(Secretaries are invited to send in notices of meetings, etc., for inclusion in this column.)

JANUARY 24.

Institution of Works Managers.

Glasgow Branch:—"Lighting as an Aid to Production," by C. J. King, at the Institution of Engineers and Shipbuilders in Scotland, Glasgow, at 7 p.m.

Institution of Production Engineers.

Derby Sub-section:—"Mechanical Handling," by F. T. Dean, M.I.Mech.E., at the Art School, Green Lane, Derby, at 7 p.m.

JANUARY 26.

North Western Fuel Luncheon Club.

"The Romance of Hydrogenation," by Dr. R. Holroyd, in the Engineers' Club, 17, Albert Square, Manchester, 2, at 12 noon for 12.45 p.m.

Institute of British Foundrymen.

London Branch:—"Synthetic Resin Core Binders," by G. L. Harbach, at the Waldorf Hotel, Aldwych, London, W.C.2, at 7.30 p.m.

Institute of Welding

The Sir William J. Larke Medal Paper at the Institution of Civil Engineers, Great George Street, London, S.W.1, at 6 p.m.

JANUARY 27.

The Institute of Metals.

Birmingham Local Section:—Symposium on "Clad Metals," at the James Watt Memorial Institute, Great Charles Street, Birmingham, at 6.30 p.m.

JANUARY 28.

Institute of British Foundrymen.

Birmingham Branch:—Annual Dinner and Dance at the Botanical Gardens, Edgbaston, Birmingham, at 7 p.m.

West Wales Section:—"The Production of High-quality Castings," by J. D. F. Yuille, at Baldwins Canteen, Landore, Swansea, at 7 p.m.

Institution of Mechanical Engineers

Extra General Meeting. Second Paper:—"Investigations into Cyclone Dust Collectors," by Professor A. J. ter Linden, at Storey's Gate, St. James's Park, London, S.W.1, at 6 p.m.

JANUARY 29.

Institute of British Foundrymen.

East Midlands Branch:—"The Venting of Cores and Moulds," by D. Killingworth, at Loughborough College, at 5 p.m.

Wales and Monmouth Branch:—"Aluminium Castings Production" film presented by the Aluminium Development Association, at the Engineers' Institute, Cardiff, at 6 p.m.

The Largest Branch

When Mr. R. B. Templeton, the President of the Institute of British Foundrymen, announced during a social function that the London Branch had attained a membership of 692, we cabled to Mr. Wm. W. Malone, the secretary of the American Foundrymen's Society to ascertain whether or not this is a world record. His reply shows very clearly that the record is still held by the Chicago Chapter with 799 members. Mr. Malone writes: ". . . the next nearest Chapter is Winconsin with 568, then North Eastern Ohio (Cleveland) with 544, and Detroit with 528." We thank Mr. Malone for the trouble he has taken and urge London to make up the deficit.

CULTURAL RELATIONS in the domain of foundry technology will be re-established between Italy and this country when Dr. A. B. Everest visits the *Centro di Fonderia* of the *Associazone Metallurgia* on January 29. He is to lecture on the subject of High Duty Cast Irons. This engagement will be followed by visits, over the period to February 7, to engineering firms located in north Italy.

Roll Founding*

Details of Procedure for Casting Large Units

By W. G. Scott

(Slightly Abridged)

Although roll founding as an art has been practised since early in the industrial era when shaping of metals by rolling as it is now understood was first introduced, it is only within comparatively recent times that the application of scientific control to this branch of industry can be claimed to have made any real advance. When it is considered that it was personal judgment based entirely on critical observation, without the advantage of scientific aids, which determined the success or failure of an extremely complex operation such as roll casting is, the skill of the older generation of craftsmen is something at which to marvel.

While increasing application of metallurgical principles has stripped much from the mystery which at one time surrounded roll making, it must be admitted that knowledge of fundamentals is still far from complete and that success still depends very much on the personal factor. This being so, can it be wondered that emphasis continues to be on the art, while science is still considered but the handmaiden?

The history of roll making runs closely parallel to that of the steel industry. As steel outputs have been increased, so roll qualities have been improved, and just as steel tonnages have reached their highest peak during recent years so have the greatest improvements in roll types been made during the same period. Since 1935 spectacular increases in roll surface hardness have been achieved by alloying, and at present cast rolls are being produced 60 deg. Shore hard in steel and up to 95 deg. Shore in iron. Not quite so spectacular but of equal importance, has been the increase in understanding of fundamental principles, and it is to the application of control based on this knowledge rather than to type development that this Paper is directed.

In the roll industry, cast rolls are termed iron or steel according to the structural state of the total carbon. Generally an iron roll, whether plain or shaped, has a soft core with the hypereutectoid carbon wholly graphitic, and a hard shell wherein all or most of the carbon is combined, the amount so combined depending on the intensity of the chilling. Steel rolls on the other hand have no apparent graphite even in compositions containing 2.5 per cent. carbon.

By adopting this simple classification, roll types fall into two groups thus affording a convenient means of describing manufacturing procedure.

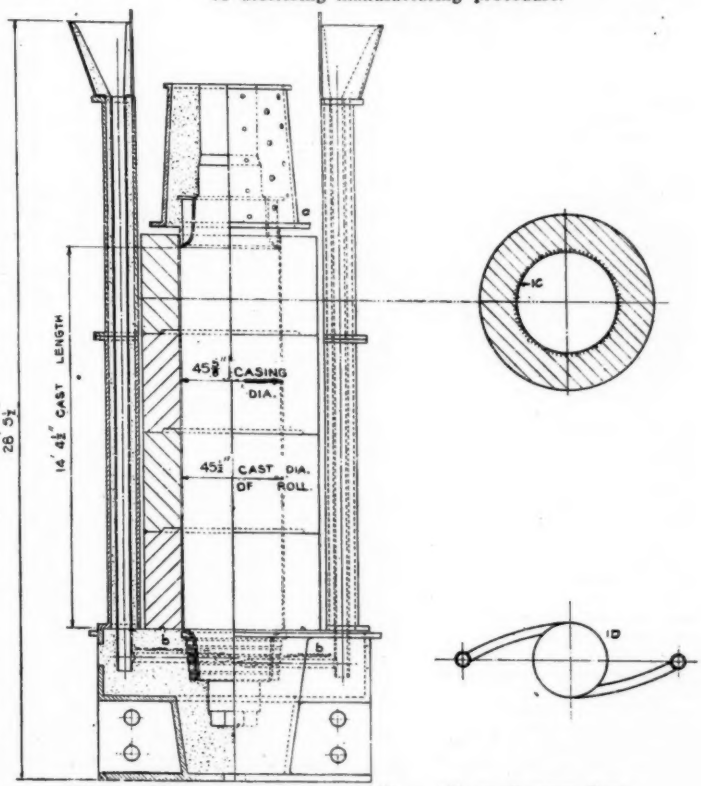

FIG. 1.—MOULD ASSEMBLY FOR 168 × 44½ IN. CHILLED ROLL.

D2

* A paper read at a meeting of the West of Scotland Iron and Steel Institute. The author is on the staff of R. B. Tennent, Ltd., Whifflet Foundry, Coatbridge.

Roll Founding

Iron Rolls

Casting.—In roll making, casting practice is as important as in any other branch of industry, possibly even more so, and in mould rigging and assembly, extensive precautions have to be taken to accommodate sometimes unpredictable factors. This applies particularly to chilled rolls. In Fig. 1 is shown the mould assembly for casting a plate roll 168 in. long by 44½ in. dia. barrel.

As can be appreciated the chief concern in casting such a roll is the production of a barrel surface, chilled to the required depth of approximately 1 in., which shall be absolutely free from blemish. Essentials in obtaining the necessary perfection of cast surface are high pouring speed, fast spin and free venting. The 46 tons required in this example were poured in 95 secs. Defects which have to be guarded against are pinhole porosity, scabbing and tears or cracks.

Unlike chill depth which for our present purposes may be assumed as being entirely a function of metal composition, pinholes or porosity, although at times caused by out-of-condition metal, can be regarded as the resultant of mould surface and casting conditions. The surest method of preventing such defects is by using a coated casing in which slots are provided for gas venting. The mould casing made of hematite iron as in ingot practice, is coated in this example with $\frac{1}{16}$ in. thickness of a specially prepared mixture consisting of 85 per cent. rock sand, 10 per cent. plumbago and 5 per cent. bentonite. The gases, generated from the sands of the drag and facing during casting, are exhausted by the vents, as shown in 1C, at a rate which must be high enough to prevent any build-up of pressure. Throughout casting, a fast and steady rate of pour must be maintained. By introducing the metal at a tangent (1D) it is made to spin at a speed sufficient to keep all dirt or dross away from the mould wall.

Scabbing is usually caused by a choked vent or by poorly bonded dressing. Besides being sufficiently refractory the $\frac{1}{8}$ in. thickness of sand facing must not flake nor buckle under heat. Hot tears occur very readily if longitudinal contraction is hindered in any way. Since contraction takes place from both ends towards the centre, the shrinkage, 3 in. in this example, is allowed to take place freely by (*a*) a sliding top neck which moves with the roll body and (*b*) layers of coke which yield to the pull exerted at the ingates.

Reference to the diameter sizes shows how important and necessary is perfect cast surface:—

Machined bore of casing		= 45.625 in.
Coating (2 in. by $\frac{1}{16}$ in.) ...	0.125	= 0.894 in
Shrinkage (0.017 in. per 1 in.)	0.769	
Roll—cast diameter		44.731 in.
Roll—finished diameter		44.50 in.

No matter whether it is plate rolls, as described, or high hardness strip rolls that are being cast, the same principles must be observed, although the methods of achieving like results may vary.

An example of a sand-cast grain roll is shown in Fig. 2. The term grain, derived from the structural

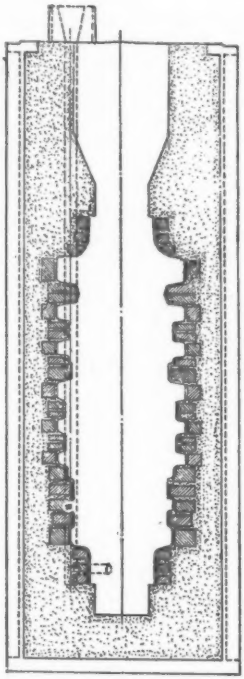

FIG. 2.—MOULD FOR GRAIN SECTION ROLL.

appearance of the cast metal, is applied to rolls densened but not chilled in casting. Such rolls are moulded in boxes with sand, faced with slurry, and finished by blacking. Passes are swept out and the casting hardened where required by iron bricks which are protected by a very thin wash of sand and blacking. Gating and casting practice is the same as for chilled rolls, and apart from normal care no special precautions are required in moulding.

Cold-blast Pig-iron.—Most makers of chilled rolls consider that for consistent results in foundry and in mill, cold-blast pig-irons are to be preferred. No one with practical experience will question the wisdom of selecting only the best raw materials for what at all times is a somewhat delicate product. How far the theory of inherent properties can be justified is difficult to determine, since such properties are not measurable. It seems remarkable that an ore should be found just when and where wanted, which on being reduced by cold blast, produced an iron of a composition correct for roll making. The fact that the chemical composition of such irons, low total carbon, low silicon, and low manganese with just the right amount of phosphorus meets the ideal specification seems to suggest an explanation contrary to the theory

of inherent properties. Although it is now known that the transmission of inherent properties, if any, is of only minor importance and is secondary to melting conditions which have been proved to be the predominating influence in determining roll properties, it is still considered that there is less risk of casting failure when the metal mixture is purely cold-blast iron.

Air Furnace

From the beginning of roll founding the air furnace has been considered the most reliable melting unit for the manufacture of chilled rolls which with the sand-cast grain rolls were for many years the principal rolls employed in rolling mills. This type of furnace, whose prototype it is believed was the puddling furnace, is still regarded as the best medium for melting iron for rolls, and except for a fractional tonnage of small rolls, all chilled rolls manufactured in this country for the ferrous and non-ferrous trades are still made from this type of furnace. Always recognised as most uneconomical in respect of fuel consumption (sometimes as high as 20 cwts. per ton, depending on charge size), efforts have been made to improve the thermal efficiency by changes in design and improved firing methods. The principal alteration in design has been the change from the camel back to the straight roof, which in many cases is formed of removable bungs, thus permitting top charging. Firing by pulverised fuel is to-day almost universal. With two exceptions, one in this country and the other in U.S.A. which still use hand firing with coal in spite of high fuel consumption, all roll makers, both here and in U.S.A., use pulverised fuel except the firm with which the Author is connected, which favours stokers. In Germany and Belgium, the other principal roll-producing countries, the air furnace is also the chief melting unit for chill irons, although in those countries a Siemens acid open-hearth type with air regeneration only is also in favour. All such furnaces are acid in character. Fig. 3 shows a stoker-fired furnace.

The improvements in design and firing methods have resulted in more efficient control over bath reactions, and when properly manipulated, the more thermally efficient present-day furnace is capable of maintaining and controlling the conditions fundamental to the old hand-fired reverberatory, which conditions, it is now known, were responsible for its pre-eminence in the chilled-roll industry.

With a constant percentage loss of elements in melting and without those complications which can arise when added hydrogen is present in the furnace atmosphere, control of metal quality is comparatively simple. The only limiting factor in the use of the air furnace for rolls is requirements of temperature. Around 1.80 per cent. is the safe minimum carbon.

Melting.—The heat log in Table I demonstrates typical melting practice for chilled rolls.

TABLE I.—*Heat Log for a Melt for Chilled Roll Metal.*

Charge :—21·5 tons. 65 per cent. C.B. iron. 35 per cent. chilled scrap. Charge analysis :—T.C. 3.31 : Si 1.24 : S 0.066 : P 0.391 : Mn 0.558. per cent. Required analysis :—T.C. 2.8 to 2.9 : Si 0.65 to 0.75 : S 0.07 to 0.08 : P 0.40 to 0.45 : Mn 0.26 to 0.28 per cent Furnace lit 10.30 p.m. (Start from cold.) Melted 6.30 a.m.

		Temp., °C.	T.C.	S.	Si.	Mn.
7.30 a.m.	Test No. 1	1,290	2.90	0.078	0.902	0.339
7.40 a.m.	100 lb. limestone					
8.0 a.m.	Test No. 2	—				
8.30 a.m.	Test No. 3	1,330				
9.0 a.m.	Test No. 4	—				
9.10 a.m.	100 lb. limestone					
9.20 a.m.	Test No. 5	1,360				
9.35 a.m.	Test No. 6	—				
9.40 a.m.	Furnace rabbled					
9.50 a.m.	Tests No. 7 Flat—Chill—	1,370				
10.20 a.m.	Tests No. 7 Broken. O.K.					0.279
10.30 a.m.						
10.40 a.m.	Furnace tapped	1,375				
11.30 a.m.	Roll cast—Wait 40 mins.	1,300				

Ladle analysis :—T.C. 2.85 : Si 0.676 : S 0.079 : P 0.418 : Mn 0.270

Slag analysis :—

	SiO_2.	FeO.	Fe_2O_3.	Cr_2O_3.	Al_2O_3.	MnO.	CaO.	MgO.
Melt	45.75	32.64	2.68	0.415	9.04	7.07	3.30	Trace
Tap	51.80	17.53	3.72	0.307	9.92	6.77	9.80	Trace

Sampling.—Judgment of chill depth is made by correlating the final fracture tests with each other and with the manganese percentage. Unfortunately, chemical analysis by itself cannot be relied upon. In theory with a definite and easily held total carbon, it ought to be simple to specify a rigid figure for silicon, but in practice it is found that for the same depth of chill the silicon content, as found chemically, can vary from 0.60 per cent. to 0.75 per cent. and on occasions even exceed this figure. This seeming divergence from what ought to be a straight line relationship may be explained by the presence of silicates. To a certain extent sulphur and manganese cancel out, the chill-forming effect of the one being neutralised by the other, according to the accepted MnS formula. Experience, however, indicates that the effect of sulphur in iron may not be quite so simple as would be expected from the MnS ratio, and sulphur in chill irons appears to be in fact next in importance to carbon.

The very narrow range of manganese—in this composition from 0.28 to 0.26 per cent. which must be

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observed as critical in determining depth of chill, shows the potency of sulphur in solution as a carbide former. The predominant element is of course carbon, the importance of silicon, sulphur and manganese being in their influence on the state and distribution of the carbon. Chill depth can be regarded as the sum of the positive chilling elements carbon and sulphur minus the negative silicon and manganese, and it is most reliably assessed by fracture in conjunction with manganese. (This applies to the standard composition only and not to compositions with alloy percentages of manganese.)

Effect of Melting Conditions

Almost an axiom in roll making is to melt from soft to correct for chilled, and from hard to correct for grain rolls, meaning that for shallow hardening as for definite chilled type, oxidation of silicon or manganese should not proceed beyond the point coinciding with the required depth of chill, and for deep penetration as required for section or grain rolls, oxidation should go as far as to necessitate a silicon or inoculating addition. How closely roll quality conforms to the standard is governed almost entirely by the state of oxidation of the melt. The atmosphere during melting down should be sufficiently oxidising to produce a slag which at the clear-melt stage has just enough iron oxide to provide the required silicon and manganese oxidation, so that the slag and metal are in equilibrium at tapping. The necessity of maintaining non-reducing conditions postulates a critical minimum solubility of oxygen.

The relationship between slag (iron oxide) and loss of elements is shown graphically in Fig. 4. These graphs also illustrate the practice which satisfies the required conditions for chilled rolls, i.e., shallow penetration. At the clear-melt stage the slag with 32.64 per cent. FeO is cinder and changes rapidly with rise in temperature and falling FeO to a dark glass. CaO as limestone is added to replace some of the FeO in the silicate and to increase slag fluidity. The activity of the slag is shown by the steady rate of silicon and manganese removal, and by the accelerated cycle $FeO—Fe_2O_3—FeO$. The levelling off in the FeO content and the corresponding slight increase in Fe_2O_3 in the final stages shows slag and metal in equilibrium and completion of refinement by atmospheric oxidation.

Quality

Chilled rolls are usually considered as comprising three zones, viz., chill shell, mottle or transition zone, and core. Related to the effect of added elements, such a method of separate assessment is valuable, but in so far as base metal quality is concerned the three zones are really interdependent. The only reliable method of comparison for chilled iron quality has, so far, been statistical means. Mechanical testing does not yield sufficient data on which a standard specification can be based. Statistical analysis has established that for maximum service expectation, structural characteristics must conform to certain well defined standards. Briefly these are as follows:—Graphite randomly distributed and correctly orientated; core, combined carbon of eutectoid composition; sulphides, cuboid shaped and dispersed at random. A feature of high strength roll irons is the wide spacing of the pearlite lamellæ. With correct graphite pattern this indicates unstressed material with good shock resistance. By alloying with nickel, manganese, molyb-

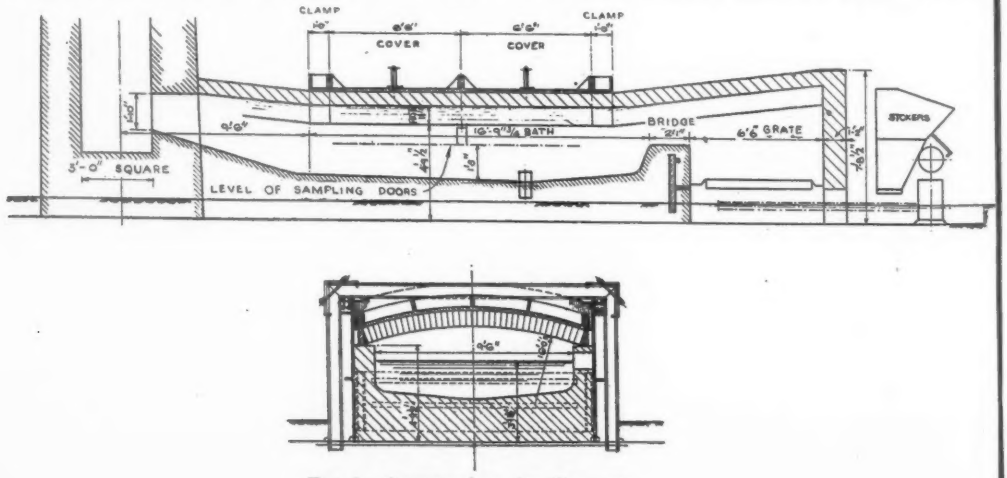


FIG. 3.—STOKER-FIRED AIR FURNACE.

denum or chromium, for the purpose of developing hardness of chill, the matrix is changed, with increasing alloy addition, progressively from pearlite to sorbite, and in the highest hardness rolls to martensite. As chill hardness increases with alloying, the core endurance limit decreases correspondingly and some form of after-casting treatment becomes necessary in order to maintain or produce in the core material, strength and resistance to shock equal to the ideal structure as illustrated.

Where heat treatment, such as stress relief or spheroidisation, cannot by itself produce the necessary strength conditions, dilution or complete replacement of the core material is the method employed. In this method the practice is to allow the chill shell to form by waiting a predetermined interval after casting, before commencing to pour through the still-liquid core either a high silicon low alloy content iron to dilute the parent metal and thus produce a core material of the required strength, or a soft iron which possesses freezing characteristics similar to the shell material and by a modification of the pouring technique to effect complete replacement of the original core metal.

A comparatively recent development in chilled rolls has been the "indefinite" type. Although of different structural features as a result of chemical composition, this type is made under the same conditions of melting, moulding, and casting, as apply to the standard roll. In contrast to the definite type of roll which has three distinct structural zones comprising (*a*) a

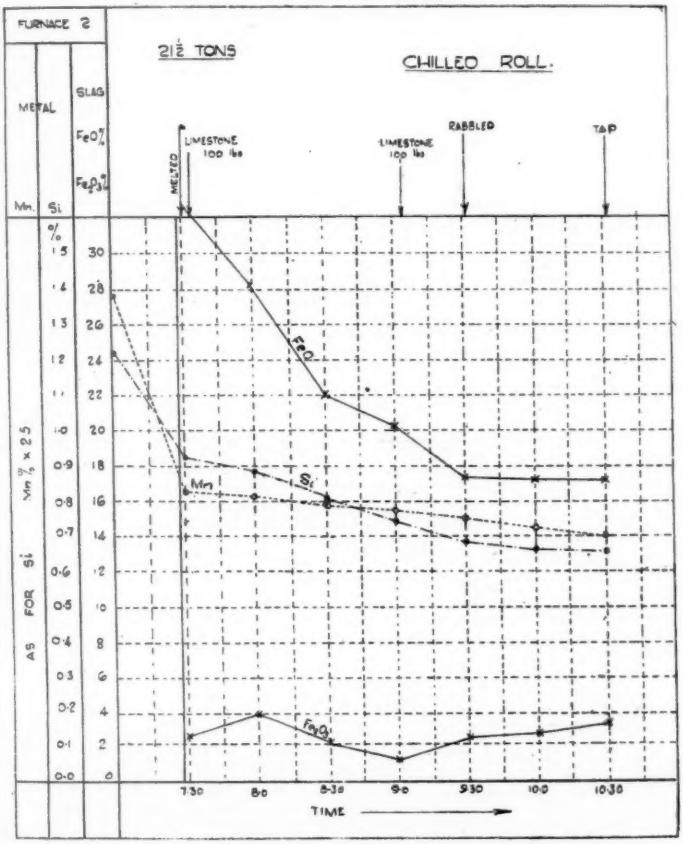


FIG. 4.—SLAG AND METAL COMPOSITION DURING MELTING.

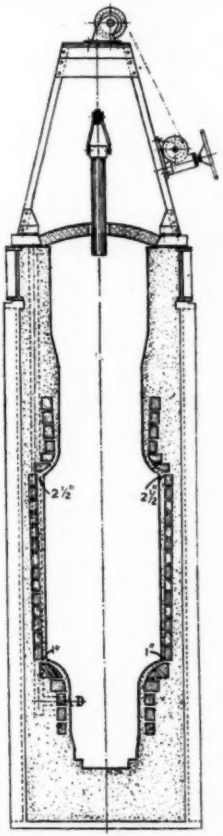


FIG. 5.—MOULD ARRANGEMENT FOR STEEL ROLL, SHOWING ELECTRIC-ARC HEATING FOR THE FEEDER HEAD.

Roll Founding

shell (approx. 1 inch in thickness) of white iron, with all of the carbon in the combined state, (*b*) an intermediate zone (less than 1 inch) of mottle or semi-graphitic iron, and (*c*) a core of graphite and pearlite, the indefinite type with a gradually decreasing amount of combined carbon from surface to centre has no distinct zone of demarcation. No matter which type of chilled roll is being made, whether of medium or high hardness, definite or indefinite, the basic principles of manufacture are the same as have been described for the standard chilled roll.

STEEL ROLLS

The problems of steel roll founding are much more complex than are those of iron. The factors which have to be observed are, first, directional solidification, and, second, good surface. The first principle of roll making is to ensure that the casting is made to freeze progressively from bottom to top. Next in importance is to mould to close profile limits so that the advantages cast structure may be translated into wear resistance.

In steel making the function of the mould is to produce the desired shape, with the mass as free as can be from contraction strains. In ingot practice this can be accomplished fairly readily by quick freezing of the metal in properly designed big-end-up moulds with hot tops. With correct mould design the laws governing directional solidification can be applied effectively to ingots, but it is only in much lesser degree that ideal mould conditions can be made to apply in roll castings.

Moulding and Casting.—In preparing moulds for rolls, requirements of progressive freezing and of surface determine the design. Since roll surface to a depth of 2 inches or slightly more depending on mill centres is what matters in service, it is understandable why (as in iron) the cast surface quality of steel rolls should also be a major consideration.

The method of moulding most commonly practised is illustrated in Fig. 5. As shown, iron bricks are set in the mould at a taper to initiate directional solidification. High pouring speeds with slow spin are employed to fill the mould quickly. Besides keeping a clean mould, fast pouring keeps to a minimum the adverse temperature gradients which would result from this method of casting. Uphill teeming is continued to the cut-off, that is, the finished roll length, and casting is completed by top pouring the sink-head. With nozzle size of 3½ inches this casting of 42 tons took 2½ minutes to pour to cut-off. The metal in the head is kept liquid by electric arc thus ensuring proper feeding of shrinkage, and at the same time serving to maintain correct conditions of solidification, namely, accelerated cooling at the bottom end and delayed cooling at the opposite end of the mass. Sweep moulding in half-boxes is general practice. Backing sand is usually floor sand reconditioned. The most satisfactory facing is a synthetic mixture of silica sand with bentonite or similar clay as bond, and finished by washing with two or more coats of silica paint.

Defects.—Casting of rolls is no more trouble free than that of other steel castings and on occasions such defects as burning-on and hot tears do occur. Of all defects which can afflict roll making the most important, because it is the most dangerous, is internal hot-tearing. Many theories have been advanced to explain this phenomenon but none so far has proved completely satisfactory. It is recognised that this type of defect can follow on failure to satisfy the requirements of progressive freezing, and that the possibility of its occurrence becomes greater as roll sizes increase. This is the reason why mass effect in steel roll founding is primarily considered in its relation to internal rupture. How such rupture can happen is illustrated by Fig. 6, which is a graphical representation of the mechanism of strain failure in large steel castings as explained by Christopher.[1] According to this postulate, metal movement, caused by replacement of contraction, has to be minimised as much as possible during freezing, and it has to be ensured that all movement taking place does so in the liquid and not in the plastic or solid states, if sound castings are to be obtained. In freezing, flow direction within the mass is towards the cooling surface which in effect pulls the metal outwardly to the sides and downwards towards the bottom. Stress resulting from transverse movement (B) can only be relieved by downwards movement along the central line (A). Should there be resistance to the downward movement of central flow, then there will be resistance to flow in all directions—shown by small arrows—resulting in a state of trapped contraction. In such a state, as resistance develops, strain shows in the semi-liquid as flow lines, in the plastic as cavities proportional in dimension to the magnitude of the transverse—longitudinal stresses, and in the solid as hot internal tears or complete rupture.

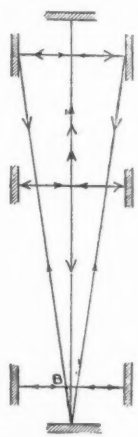


FIG. 6.—DIAGRAM SHOWING MECHANISM OF COOLING STRAINS.

The concept of transverse and longitudinal flow relative to stress agrees well with experience. In practice it is found that the most difficult of all roll castings to make are those of large dimensions, particularly where the ratio of length to diameter is small. Contraction stress as the result of unsatisfied flow offers a reasonable explanation why this should be so, since with transverse flow becoming greater with increase of diameter size, at the same time it becomes more difficult to satisfy by longitudinal flow. Much of the difficulty experienced in casting large rolls can be attributed to the fact that with increasing mass, the mould becomes less effective in producing the proper temperature gradients in the solidifying metal. As the mould becomes saturated with heat its effect on the casting becomes less and a point is reached where the influence

of the mould in the control of direction and speed of solidification is largely cancelled.

The most notable of the means adopted in casting in an endeavour to overcome unsoundness arising from adverse solidification conditions are top-pouring and hollow-casting. The method of top-pouring is that practised in Germany. In arriving at the correct temperature gradient in the mould one of two techniques is employed in casting, either " arrested-pour " or " temperature-control."

In casting by the arrested-pour method, instead of pouring at a steady rate with a continuous stream, pouring is stopped at intervals to permit a drop in temperature of the metal already in the mould before additional hot metal is poured. The technique is to pour the drag, wait possibly one minute, pour one ton, wait one minute, pour one ton, wait and so on. The amount poured per shot and the interval between shots is controlled according to the ladle temperature. It may take from 20 to 30 minutes to complete the pouring of a 20-ton roll with 20 or more arrests.

The principle of the second method of top-pouring is to cast at low temperature, the practice being based on the contention that optimum freezing conditions can only be obtained by delivering the metal to the mould when at a temperature between the liquidus and solidus according to the iron carbon diagram. Temperature is controlled by varying the nozzle diameters of the ladle and of the tundish, which is employed in this practice. In addition to having the ladle prepared with a nozzle of 35-50 mm. in diameter, a series of small moulds which are in reality nozzles (20-50 mm.) made into tundishes are held in readiness. If more than the expected 50 deg. C. loss in temperature from tap to mould is required the metal is tundished with nozzle size chosen according to the temperature drop necessary.

A recent development in this country and in U.S.A. has been the practice of hollow-casting as distinct from chambering. In this method an air or water cooled core of from 3- to 6-in. diameter forms the central axis of the casting. By thus reducing the cross-sectional area by half, the most dangerous of the effects of mass are eliminated. Apart from obviating the disadvantage of poor surface attendant on top-pouring, this latter method is designed to increase the speed while maintaining control of the direction of solidification.

Steelmaking.—By far the greatest tonnage of cast-steel rolls is made from the acid open-hearth furnace. Furnaces with capacities of from 20 to 60 tons are in most respects similar in design to the usual fixed open-hearth type. A slight departure from normal in one case is that in which a 6 ft.-long central portion of the roof is made in the form of a bung so that it can be lifted off to permit charging heavy roll scrap. In this country, melting is by producer gas with air and gas regeneration. In U.S.A., according to cost and availability, the fuel may be natural gas or oil with air regeneration. Charge materials are low-phosphorus and sulphur hematites, old rolls, heads, foundry returns, and purchased scrap such as crankshafts and heavy ship scrap.

At the works with which the Author is connected all charges are calculated on the basis of carbon, silicon and manganese, the percentage of silicon and manganese being charged in relation to the metal properties desired. Whether high or low content of these elements is charged, depends on roll size and service conditions. With high percentages (*e.g.*, 1.0 per cent. silicon, 1.0 per cent. manganese) furnace working follows normal practice with some silicon reduction to the bath during refining. A slightly different procedure is followed with low silicon and manganese content charges, of which an example is given.

With steelmaking in general, it is recognised that metal quality is determined by melting conditions, and various theories such as grain size, nature of inclusions, gas content, *etc.*, have been advanced to explain steel properties in relation to furnace practice. In making steel for roll castings, melting technique is based on the assumption that the rate of freezing is a function of bath conditions, and that the speed at which the metal passes through the freezing range depends on the method of melting and refining practised. On the postulate that rate of freezing is governed by bath conditions, it follows that temperature and slag are the controlling factors.

Temperature

It is usual to consider the casting temperature in relation to fluidity or castability. Although investigation[2] appears to have proved that the phenomenon of apparent fluidity or viscosity, as measured by length of run in a test mould, is chiefly a function of temperature, it does not necessarily follow from this that liquid steels of the same composition and at the same recorded temperature cannot behave very differently. Support for the view that metal behaviour in respect of freezing characteristics cannot be explained entirely by fluidity measurement can be deduced from Ruff's work.[3] In comparing two steels, chromium-molybdenum and nickel-chromium-molybdenum, he found that with the same solidification temperature (within 1 deg. C.) both steels had to be poured from the same temperature, although the nickel-containing steel, on measurement, gave the much greater length of run. In recording his results, Ruff is careful to emphasise the importance and influence of superheat on castability. A reasonable inference which might be drawn is that the different fluidities (as measured) of the liquids before casting must be reflected in the solid and be transmitted during freezing.

Slag.—There is general agreement that silicon reduction of the acid bath is the surest method of producing quality steel. This means that the furnace is at high temperature with a slag high in SiO_2 and low in FeO. The advantages of silicon reduction are presumed to be derived from the nature of the reaction of the nascent silicon with the dissolved oxides, giving a steel which is remarkably free from inclusions. Consideration of the relation of FeO slag to quality, in amounts which have been proved critical, and of the effects of over-reduction, suggests that inclusions are only one feature of quality and that their nature, as with silicon reduction, is only incidental to a determining condition. On this hypothesis and from analogy with the behaviour of cast iron in respect of supercooling, it has been reasoned that crystallisation as influenced by rate of freezing is the governing factor.

(To be continued)

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

CARDING MACHINE CASTINGS

To the Editor of the FOUNDRY TRADE JOURNAL

SIR,—In view of the interest shown in the query by Mr. Cheng in respect to the manufacture of carding engine cylinders, the accompanying sketch will show more clearly how such cylinders should be made. This sketch is a repeat from my Paper published in 1927. The sole difference from the casting of Mr. Cheng lies in the fact that those described by the writer have circumferential and vertical strengthening ribs on the inside. The former are produced in the strickling of the core and the latter by grooving the dried core. The method outlined is still the best practice, in spite of the passing of twenty-one years.

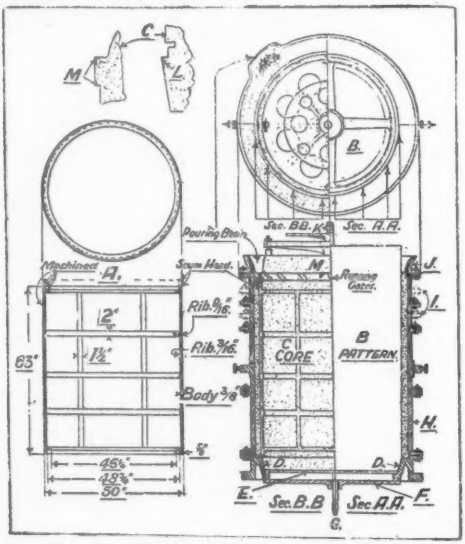


FIG. 1.—MOULDING LAYOUT FOR CARDING MACHINE DRUM CASTINGS.

The following points emerge in the manufacture of such a class of casting:—(1) The castings are comparatively thin as related to their large size—$\frac{3}{8}$-in. for $\frac{1}{4}$-in. machined section. (2) Moulds and cores must be thoroughly dry to avoid the slightest disturbance in the molten metal during its passage into the mould. (3) The mould and core coating must be of a highly refractory nature, bonded with the minimum of a gas-free binder (generation of gas to be minimised). This permits a thin coating of refractory to be applied. (4) A suitable metal is: Total carbon, 3.25 to 3.40; silicon, 2.00 to 2.20; phosphorus, 0.70 to 0.80; manganese, 0.65 to 0.75, and sulphur, below 0.10 per cent. (5) The metal should be poured at a very high temperature, not lower than 1,425 deg. C. (6) Head metal of 2 in. only is needed. As distinct from castings of thicker section, the head takes care of only a small amount of sullage or mould dirt. Actually, due to the thin section of the casting, any foreign matter entering with the metal is trapped, and will not float into the head unless it enters very late during the pouring operation and, indeed, within two or three inches of the head. (6) Provision must be made for releasing the core very quickly after solidification—whilst the casting is above 850 deg. C., otherwise the casting will fracture.—Yours, etc.,

E. LONGDEN, M.I.Mech.E.

P. R. Jackson & Company, Limited,
Salford Works, Hampson Street,
Manchester, 5.
January 10, 1949.

Science and Industry

The British Iron and Steel Research Association, of 11, Park Lane, London, W.1, announce that they will now admit all firms and individuals interested in the manufacture and use of iron and steel, but not in themselves makers or processors, to a newly established category of Associate Membership.

B.I.S.R.A's activities since its formation in 1945 have largely concerned the making, and shaping and the properties of iron and steel, and have clearly shown how researches of this nature relate closely at one end with the industry's suppliers of raw materials and capital equipment, and at the other with the users of its products. Co-operation at each end has been close, as, for example, in work on the design of new plant which has involved suppliers, and in work on a wide variety of corrosion problems which has involved users. The present step gives firms and individuals of allied or interested industries a more direct opportunity of influencing the Association's research programme (at present numbering some 400 projects), and of having access to research results at the earliest possible moment. For example, Associate Members will receive research reports and will be able to attend the technical Conferences, numbering about 20 yearly, which are a feature of B.I.S.R.A's information methods, and which cover almost every aspect of the Association's work.

The organisation of B.I.S.R.A. into six largely autonomous Divisions enables Associate Members, if they wish, to restrict their participation to selected fields. Trade Associations are not eligible. Associate members will be drawn, it is expected, from a wide range of other industries, and provide another link in the essential bond between industry and science.

MR. OVE HOFF has recently been appointed Professor in Foundry Technology at the Royal Technical High School, Copenhagen.

MR. V. O. CUTTS, manager of the electric-furnace department of the General Electric Company, Limited, is leaving the country shortly for a business trip which will take him across the world.

Graphitisation in the Malleable Process*

Review of Present Knowledge and Future Possibilities

By H. G. Hall, F.I.M.

Fundamental Reactions

The decomposition of cementite in the solid state is a very complex process, not yet completely understood and further research is desirable, particularly concerning the reversible reaction, $Fe_3 \rightleftarrows C3Fe+C$, and the influence upon it of normal, alloying, and trace elements. The structure of the graphite nodule formed in irons containing the sulphur predominantly as manganese sulphide is shown to consist essentially of aggregates of small and apparently randomly orientated graphite flakes as shown in Fig. 1. When free iron sulphide is present at the annealing temperature, the graphite nodules occur in a different form, having a spherulitic structure (Fig. 2). The use of a dilatometer has enabled graphitisation/time curves to be obtained. Typical curves are shown in Fig. 3. The shape of these curves has revealed distinct differences related to the type of nodule formed. The curve for an iron giving the spherulitic type of nodule indicates that there is an incubation period during which little or no graphite forms. The conclusion is reached that the mode of occurrence of the sulphur is the main difference between blackheart and whiteheart malleable irons. The reaction $FeS+Mn \rightleftarrows MnS+Fe$ is therefore of fundamental importance. Investigations into the effect of varying the manganese : sulphur ratio disclose that a critical condition is reached when the manganese content is equal to the sulphur content in terms of these chemical equivalents. For instance, when the manganese content equals 1·72 × sulphur content, it is suggested that flake-aggregate graphite nodules form around particles of manganese sulphide, which act as nuclei. Also, it is postulated that the spherulitic type of graphite deposits on nuclei of iron sulphide.

*Summary of a Paper presented on behalf of the Institute of British Foundrymen to the *Association Technique de Fonderie*. The Author is a director of Castings, Limited, of Walsall.

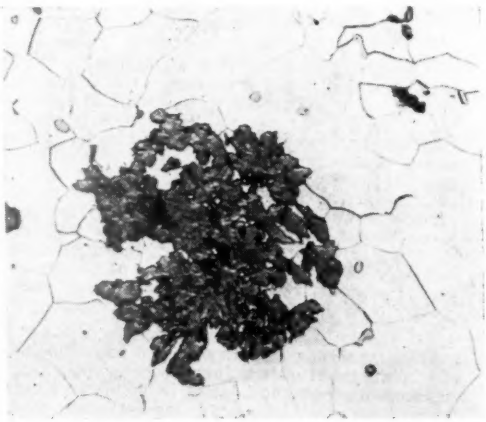


FIG. 1.—GRAPHITE NODULE OF THE FLAKE-AGGREGATE TYPE. × 300

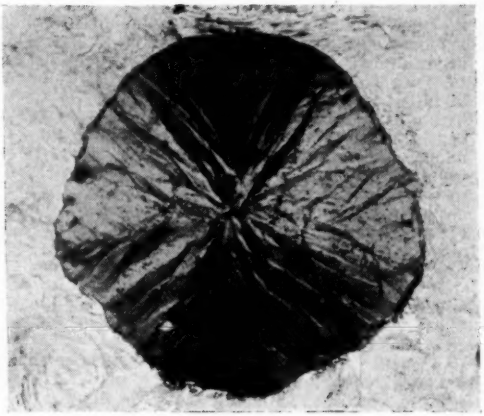


FIG. 2.—GRAPHITE NODULE OF THE SPHERULITIC TYPE. × 350.

Rôle of Iron Sulphide

It is important to note that iron sulphide must be present at the annealing temperature in order to obtain the spherulitic nodules. Nodules having an intermediate structure between that of the truly spherulitic type and the flake-aggregate type are shown to occur in irons with a moderate excess of sulphur over that required to neutralise the manganese. An excess of this amount would be indicated by the presence of iron sulphide in the structure at room temperature. This excess, however, could be wholly or partly dissolved in manganese sulphide at elevated temperatures; in this case it would allow the formation of nodules of the flake-aggregate type. Thus, in irons of intermediate

Graphitisation in Malleable Iron

composition both types of nodules can be produced after full annealing as shown in Fig. 4.

Factors affecting Graphitisation Rate

Graphitisation/time curves have been obtained for many variations of the manganese:sulphur ratio. using two levels of silicon content. Excesses of either manganese or sulphur are shown to substantially increase the time necessary for maximum graphitisation. The influence of the higher silicon contents is very clearly demonstrated in these curves. Nodules of both types form at the cementite/austenite interfaces. The number of such nodules is, therefore, governed to some extent by the prevalence of these interfaces and is thus dependent on the cooling rate from the molten state. The nodule number, however, is not fixed for a given white iron, but may be increased by a slow rate of heating to the annealing temperature; it seems that the nuclei are activated at temperatures below the critical range. Pre-quenching white iron from above the critical range also considerably increases the number of nodules formed during subsequent annealing. It is concluded that the presence of some martensite in the as-quenched structure is a necessary condition for the treatment to have any effect. Whether this results in additional cementite/austenite interfaces and produces a sub-division of the sulphide particles is a matter for further investigation. Pre-quenching has a similar effect on irons in which the spherulitic type of nodules form.

Effect of Alloying and Residual Elements

Work on the influence of alloying or residual elements on compositions containing manganese sulphide is showing progress. The effect of 0.08 per cent. of aluminium is to substantially increase the nodule number and that of tin is shown to decrease the nodule number. Some criticism is offered. The statement that small percentages of boron increase the number of nodules formed and accelerate graphitisation is also open to criticism. Nodule number is known to be influenced by either the gas content of the white iron or the gas phase present in the annealing operation; the effect

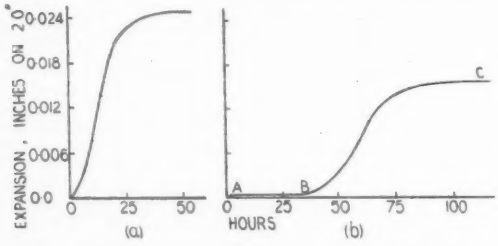


FIG. 3.—GRAPHITISATION: TIME CURVES FOR (*a*) IRON CONTAINING A BALANCED SULPHUR TO MANGANESE RATIO, AND (*b*) IRON CONTAINING IRON SULPHIDE AT THE ANNEALING TEMPERATURE.

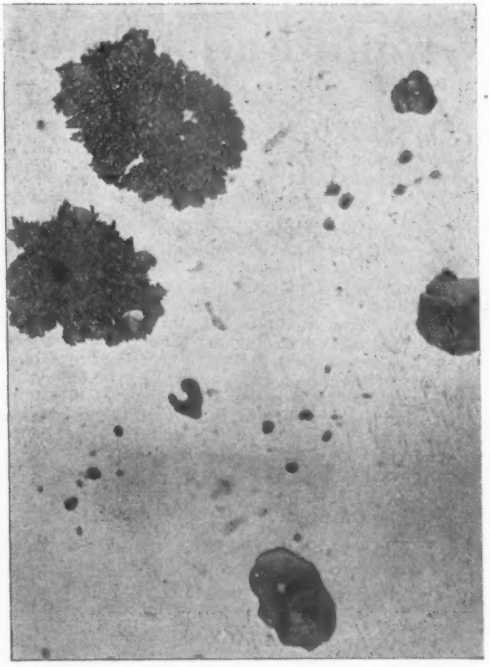


FIG. 4.—TWO TYPES OF GRAPHITE NODULE, SPHERULITIC AND INTERMEDIATE, EXISTING IN THE SAME SAMPLE. × 300.

of hydrogen in the annealing atmosphere is to reduce the nodule number. The possibility that a slow rate of heating has an effect on the distribution of hydrogen in the white iron is suggested. In connection with these experiments, a unique structure is reported to be obtained on annealing white iron in perfectly dry hydrogen, the carbon migrating to the surface layers and being deposited there as flake graphite. The decarburising power of pure dry hydrogen is limited, but water vapour in the hydrogen greatly increases it. Variables derived from the melting operation are dealt with at some length—oxidising atmospheres being considered necessary by the Author to obtain a sufficient number of nodules to allow of speedy annealing.

Effect of Raw Materials

The graphitising rate may depend upon the amount of graphite in the melting furnace charge, or on the late additions of ferro-alloys prior to tapping. Examples can be given of the influence of raw materials; pig-irons of apparently similar composition can produce white irons of different degrees of "annealability." Consideration of this data stresses the complexity of the graphi-

tising reaction which may be regarded as a sequence of changes involving the formation or activation of nuclei upon which the graphite can form, the solution of cementite in iron, its dissociation into the elements iron and carbon, the diffusion of carbon either before or after dissociation, and the crystallisation of graphite. The diffusion rate is generally accepted as controlling the reaction velocity, although this does not explain the influence of certain elements, some known to decrease the rate of graphitisation and some to increase it, and all of which decrease the rate of diffusion. Cooling of the saturated solution of carbon in gamma iron and graphite down to (and through) the critical range is of great interest. It is considered that irons containing sulphur predominantly as manganese sulphide can safely be cooled quickly to the critical range, care being necessary in cooling irons containing iron sulphide, so as to avoid the precipitation of the excess carbon as cementite. It is felt that much more attention should be devoted to a study of the cooling of these iron-sulphide-rich irons, and that better physical properties would result. In irons with a manganese-sulphide content, graphitisation is faster between A_1-stable and A_1-metastable phases than at temperatures just above this range, and proceeds much faster than at temperatures just below the range. Careful consideration of these facts should enable the more modern batch-type and continuous annealing ovens to be more efficiently used.

A Modified-process Malleable Iron

Towards the end of the Paper the Author gives a practical example of how some of the data presented on the graphitising reaction, could be used in commercial production. The production of thin-section malleable castings, capable of being machined at high speeds, is described. For this, melting is carried out in an oil-fired rotary furnace. With careful selection of pig iron, addition of aluminium, and the use of a high-carbon and low-silicon composition, together with a sulphur content neutralised by sufficient manganese, a white iron of controlled composition is produced. The annealing process is a combination of blackheart and whiteheart practice. The resultant product breaks with a blackheart type of fracture, and possesses adequate tensile strength coupled with a high degree of ductility. The microstructure of this material is shown in Fig. 5.

In the concluding paragraphs the Author discusses the development of the gaseous annealing process for the production of whiteheart malleable cast iron. The ovens for this process are heated by means of electricity or gas-fired radiant tubes. The de-carburising atmosphere initially is generated by the reaction between the entrapped air and the carbon of the castings, in a sealed chamber. This atmosphere is circulated and regenerated by the addition of more air as required. The introduction of small quantities of water vapour has been found to accelerate the de-carburising reaction. Finally, the Author records his indebtedness to his associates and to the British Cast Iron Research Association for help in preparing and illustrating the Paper, and quotes an exhaustive list of references to published literature.

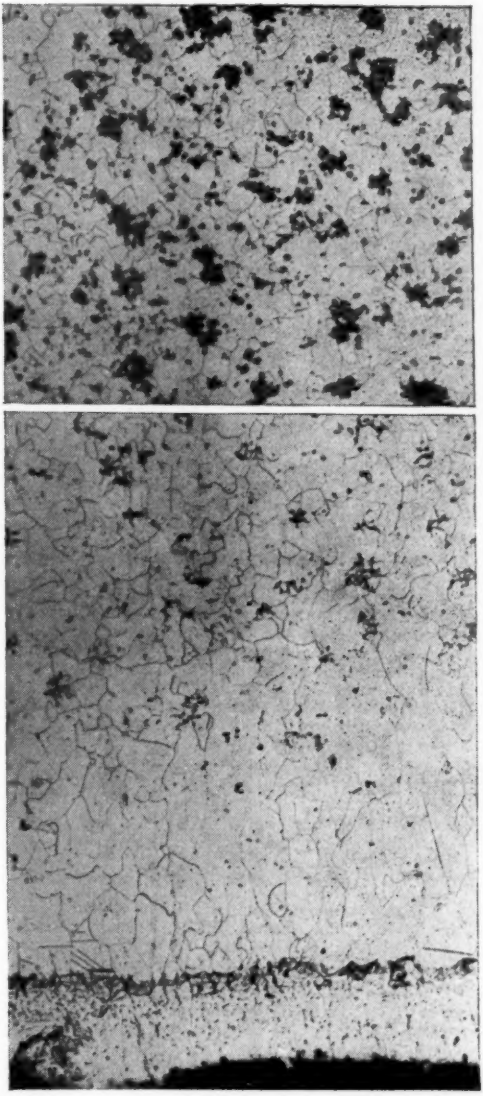


FIG. 5.—STRUCTURE OF SPECIAL MALLEABLE IRON, × 60.
Centre-section Structure in the upper photograph and Edge Structure in the lower.

The Institute of Metals

Annual General Meeting

The Annual General Meeting of the Institute will be held at the Institution of Mechanical Engineers, Storey's Gate, London, S.W.1, March 30 and 31, and at 4, Grosvenor Gardens, London, S.W.1, on April 1.

PROGRAMME

WEDNESDAY, MARCH 30

Morning Session:

10.0 a.m.:—Formal business and Presentation of the Institute of Metals (Platinum) Medal for 1949. Discussion of Papers by: (1) Hallowes: "The Working Behaviour of Phosphorus-Deoxidised Coppers Containing Bismuth"; (2) Entwistle: "The Damping Capacity of Metals in Transverse Vibration"; and (3) Entwistle: "The Effect of Grain-Size on the Damping Capacity of Alpha Brass."

Buffet lunch (price 6s.) for ticket holders at the Institution of Mechanical Engineers.

Afternoon Session:

2.30 p.m.:—Discussion of Papers by: (1) Blazey, Broad, Gummer and Thompson: "The Flow of Metal in Tube Extrusion," and (2) Rogers: "The Promotion and Acceleration of Metallic Corrosion by Micro-Organisms."

THURSDAY, MARCH 31

Morning Session:

10.0 a.m.:—Symposium on the Metallurgical Aspects of Non-Ferrous Metal Melting and Casting of Ingots for Working. A general discussion on the following Papers:—(1) Bailey and Baker: "Melting and Casting of Non-Ferrous Metals"; (2) Waddington: "The Production of Refined Copper Shapes; (3) Murphy and Callis: "Melting and Casting of Aluminium Bronze Ingots for Subsequent Working"; (4) Bond-Williams: "The Application of Flux De-gassing to Commercially-Cast Phosphor-Bronze"; (5) Cook and Fletcher: "The Melting and Casting of Brass"; and (6) Bradbury and Turner: "The Melting and Casting of Nickel Silver at the Works of Henry Wiggin & Company, Limited."

1.5 p.m.:—Buffet Lunch (price 6s.) for ticket holders at the Institution of Mechanical Engineers.

In the afternoon the symposium will be resumed. The general meeting will be adjourned for the evening at 5.0 p.m.

At 7.15 for 7.30 p.m. there is to be a Dinner Dance at the Savoy Hotel, Strand, W.C.2. Tickets: Single, 31s. 6d.; double, 3 guineas. Carroll Gibbons Blue Room Orchestra. Evening dress. Dancing until 1 a.m. Tables are bookable immediately.

FRIDAY, APRIL 1

Morning Session:

10.0 a.m.:—Discussion of the following papers:—(1) Varley: "The Recovery and Recrystallisation of Rolled Aluminium of Commercial Purity"; (2) Pumphrey and Jennings: "High-Temperature Tensile Properties of Cast Aluminium-Silicon Alloys and their Constitutional Significance"; (3) Pumphrey and Jennings: "A Consideration of the Nature of Brittleness at Temperatures above the Solidus in Castings and Welds in Aluminium Alloys"; (4) Pumphrey and Moore: "A Consideration of the Nature of Brittleness at Temperatures Below the Solidus in Castings and Welds in Aluminium Alloys"; and, if time permits: (5) Burden and Barker: "The Measurement of Grain-Size of Tungsten and Tungsten Carbide Powders Used for the Manufacture of Hard Metal."

(*Concluded at the foot of Column* 2)

What is an Employers' Association?

A letter received from Mr. Eric L. Heathcote, the secretary of the Light Metal Founders' Association, takes us to task for referring to this organisation as an employers' association, as he asserts this term gives the impression that questions of labour and wages are dealt with. This is not the case, and so far as we are concerned, we are not, to the best of our knowledge, the official organ of any association dealing with labour and wages. We sincerely regret that any such impression was given, but we are still left with the difficulty of finding a suitable alternative term for an association, the membership of which is reserved to firms and not individuals, and we would welcome suggestions from our readers as to an appropriate adjective. We note with interest that the wage-negotiating associations are referred to in a current bulletin issued by the Council of Ironfoundry Associations as "Masters' Associations."

New Catalogue

Foundry Plant

Stone-Wallwork, Limited, of 157, Victoria Street, London, S.W.1, have sent us three folders covering various subjects embraced by this general heading. The first, in a one-page leaflet carried out in red and white, describes and illustrates a type of moulding box clamp. Though quite simple, it is difficult to describe in words; it is, however, being manufactured in seven sizes ranging from 6 to 18 in. The second publication, which the reviewer esteems to be easily the best, covers precision moulding machines. It is a six-page folder and has been produced in a particularly pleasing shade of light blue. No fewer than seventeen types of machines are illustrated, which gives a proper indication of the range now available for the manufacture of sand moulds. The third catalogue, carried out in yellow and white, covers mechanical handling. It is also a six-page folder. A risk has been taken by the printing of contiguous pictures. Whilst the contrast is sufficiently wide to make a presentable job of the front cover, it has failed on the page illustrating "distribution"; "continuous milling" and "rapid knockout." This page would have been improved by the insertion between the pictures of a white space, say about $\frac{1}{16}$ of an inch wide. The photographs used, however, are excellent. These three folders are available to our readers on writing to the publicity manager (Mr. D. H. Floyd) at the Victoria Street Office, London.

Steel Production in 1948

Success of Home Scrap Drive

Steel production in 1948 not only exceeded the original target of 14 million tons, but it also substantially exceeded the revised target of 14¼ million tons. Last year's output totalled 14,877,000 tons, which is by far the highest annual output reached in the history of the industry. Production was no less than 2 million tons more than in the previous year and compared with 13,222,000 tons in the best previous year, 1939.

Output of steel in December was at the record annual rate of 14,678,000 tons. Output in every month of the year except July, which was affected by holidays, showed a record performance by the industry, as compared with any previous year. An outstanding feature of the year was the success of the industrial home scrap drive, launched by the industry in October, 1947, and it is felt that raw material supplies are again likely to be the main factor affecting performance during the coming year.

Pig-iron production in December was at an annual rate of 9,150,000 tons, against 8,561,000 tons a year ago. Output of pig-iron in 1948 totalled 9,276,000 tons, as compared with 7,785,000 tons in the previous year.

The following table compares the "Economic Survey" forecasts for 1948 with the actual outcome for the year. The figures show clearly that expanded supplies of scrap have enabled this high steel production to be attained.

—	Forecast.	Performance.
Steel ingots and castings production	14,000,000	14,877,000
Scrap—home bought (receipts) ..	3,700,000	4,550,000
Scrap—imported (receipts)	850,000	800,000
Pig-iron production	9,200,000	9,276,000
Coke (excluding foundry and gas coke)	10,348,000	10,420,000

Latest output figures (in tons) compare as follow with earlier returns:—

	Pig-iron.		Steel ingots and castings.	
	Weekly average.	Annual rate.	Weekly average.	Annual rate.
1948—November ..	185,300	9,636,000	303,100	15,760,000
December ..	176,000	9,150,000	282,300	14,678,000
1st quarter ..	174,700	9,084,000	287,200	14,933,000
2nd quarter ..	182,000	9,464,000	294,700	15,325,000
3rd quarter ..	175,800	9,143,000	269,200	13,998,000
4th quarter ..	181,100	9,415,000	293,300	15,250,000
Year	9,276,000		14,877,000	
1947—November ..	165,900	8,627,000	272,600	14,174,000
December ..	164,600	8,561,000	243,200	12,646,000
1st quarter ..	134,400	6,990,000	216,000	11,232,000
2nd quarter ..	141,600	7,362,000	244,100	12,694,000
3rd quarter ..	146,700	7,626,000	235,400	12,240,000
4th quarter ..	163,600	8,505,000	263,100	13,679,000
Year	7,785,000		12,724,000	

THE CARBON DIOXIDE COMPANY, LIMITED, will move into new premises at Abbey House, Baker Street, London, N.W.1, on February 7 (telephone: Welbeck 2332).

Steel Nationalisation Threat

A Conservative Party Pamphlet

"Everyone knows that the Socialist Government intend to nationalise the greater part of the iron and steel industry, and that they have, for fear they will be baulked in this project, rigged the Constitution to suit their own ends."

This blunt declaration is at the head of a 16-page pamphlet on the steel industry, issued by the Conservative Political Centre, the second of the "Inside Industry" series. The greater part of the pamphlet, however, is a purely factual and objective account of the growth and importance of the industry, its complexity, the status of its workers and the happy relations which have existed between them and the employers.

The pamphlet points out that "the present shortage of steel is not due to disappointments and deficiencies in output, such as have been experienced in the coal industry, for the steel industry has been breaking all records. It is due to the abnormally high demand for steel." Over-centralised control by the Ministry of Supply and other Government departments has not helped. Another point brought out is that steel prices are much lower in relation to those ruling before the war than wholesale prices in general. In October, 1948, coal prices were 145 per cent. above pre-war, but steel was only 70 per cent. higher.

Only when nationalisation is discussed does the pamphlet depart from the impartial, and here it is uncompromising. Of the Steel Bill, the writer of the pamphlet comments: "It places the industry's development plan in jeopardy. It threatens a wide range of manufacturing industries with scarcely fair competition with a State Corporation possessing complete power over their supplies of raw materials." To describe the steel industry as a monopoly is incorrect, and the author concludes: "It is difficult to see how an objective observer viewing the industry to-day with its vast plan of development being put into operation, its production records, its increased output per man-year, its low prices, its immense contribution to our export drive, its good labour relations and its progressive management, could fail to agree with Mr. Churchill that there is no better foundation for steel nationalisation than 'doctrinal fallacy and partisan intrigue.'"

MANUFACTURERS' PRICES for galvanised hollow-ware were increased on Monday under a new Board of Trade Order, as a consequence of the increase in the price of zinc at the beginning of December. The prices were increased from the previous level of 13¼ per cent. above the lowest price charged in the basic period (as defined in Article 10 (1)) to 19 per cent. above the figure. The Order, which was made in consultation with the Central Price Regulation Committee, is the General Hollow-ware (Maximum Prices) (Amendment) Order, 1949 (S.I. 1949, No. 27, price 1d).

Obituary

MR. COLIN CRAMER MILLIGAN, a director of J. W. Wells (Metals), Limited, Manchester, died on January 6. He was 53.

MR. THOMAS G. SHEARER, formerly manager of Thermotank, Limited, Govan, Glasgow, died on January 1.

MR. JAMES PETRIE, late of William Beardmore & Company, Limited, steel manufacturers and founders, of Glasgow, died on January 9, aged 79 years.

MR. GEORGE WILLIAM SHAW, a director of Shaw Bros. (Ironfounders), Limited, Knottingley, Yorks, died on January 4 at the age of 73.

MR. HENRY MANSELL PIPER, secretary of the British Employers' Confederation since 1928, died in London on January 7 at the age of 58, after a brief illness.

MR. THOMAS ROSS, who was for many years a director of William Ross & Sons, Limited, engineers and brassfounders, etc., of Glasgow, has died. He was 85.

MR. EDGAR BARKER, who died in hospital on January 7, was a director of Garton Sons & Company, Limited, manufacturers of core compounds, of Battersea, London, S.W.11.

MR. JOSEPH HOOD STOTT LAWSON, who died on January 7, at the age of 73, was a director of the National Boiler & General Insurance Company, Limited.

MR. HARRY SEVERN, who has died at the age of 55, was assistant buyer for the former Sheepbridge Coal & Iron Company, Limited. He had been with the company for 41 years.

MR. GEOFFREY F. R. BARRETT, who died on January 5 after a long illness, was formerly managing director of the Hoffman Manufacturing Company, Limited, ball and roller bearing manufacturers, of Chelmsford, Essex. He was 76.

MR. ALBERT EDWARD DOVER, chairman and consulting director of Dover, Limited, makers of cycle and motor accessories, etc., of Northampton, has died at the age of 85. He was also chairman and a director of the Spiral Tube & Components Company, Limited, Derby.

MR. GEOFFREY C. HIBBERT, a director and general manager of E. H. Jones (Machine Tools), Limited, London, N.W.9, died on January 7. He was 48. Mr. Hibbert had held the position of leading executive with the organisation for the last three years. He was a man of extreme kindness and was a hard worker. Mr. Hibbert had been associated with E. H. Jones (Machine Tools), Limited, through a long period and was a close friend of the late Mr. Ernest H. Jones, founder of the organisation. He died after a brief, but extremely severe, illness.

AN AUCTION SALE of industrial, electrical, engineering equipment, etc., will be held at the Ministry of Supply Depot, near Leeds, from February 1-11. Catalogues, price 6d. each, may be obtained from the auctioneers, Oliver, Kitchen & Flynn, 30, Albion Place, Leeds, 1.

Wrought Aluminium and Aluminium Alloys

Features of New British Standard

The British Standard for wrought aluminium and aluminium alloys, sheet and strip (B.S. 1470:1948), which has recently been published by the British Standards Institution, is the first of a comprehensive series of British Standards for aluminium and aluminium alloys for general engineering purposes. Certain of these materials are already covered by British Standards, but work has been in progress for a considerable time on schedules which would incorporate a comprehensive range of materials in various forms, adequate for the large majority of general engineering applications. The selection of grades of aluminium and the alloys to be included in the schedule has been the result of close collaboration between manufacturers, users, scientific organisations and others interested in the manufacture and utilisation of light alloys, through the established machinery of the B.S.I.

Work is well advanced on similar schedules for aluminium and aluminium alloys in the following wrought forms, and for aluminium and aluminium alloy ingots and castings:—Tubes; forgings; wire for rivets; welding wire; wire for general purposes. A draft British Standard for aluminium and aluminium alloy bars, rods and sections has been circulated, and this will form the basis of a further B.S. in the series. Work is also in hand on a B.S. for aluminium and aluminium alloy plates.

One particularly interesting feature of the British Standard is the system of nomenclature. The Institution has adopted a system of letters and numbers denoting material, form of product, heat-treatment and condition; this system will be used throughout the series of British Standards for aluminium and aluminium alloys for general engineering purposes. Great care has been exercised in the choice of the symbols to avoid ambiguity and confusion with other systems of identification. It is hoped that the system will be adopted throughout industry, and that care will be taken to ensure that the correct symbols are employed to avoid unnecessary delay and misunderstanding, especially at first when the system is unfamiliar.

Copies of this British Standard can be obtained from the British Standards Institution, 24, Victoria Street, London, S.W.1, price 3s. 6d., post free.

AFTER THE FUEL CUTS and rigorous winter conditions of 1947, the Scottish pig-iron trade has experienced comparative tranquillity during the past year and production has proceeded without interruption. With ample supplies of ore for the blast furnaces and favourable conditions, it was expected that something approaching record output would be obtained and, while the returns for December are not yet available, the total production of pig-iron in Scotland is likely to be not far short of the record figure of 900,000 tons attained in 1920.

Personal

MR. A. M. GEDDES is no longer connected with Mackay Industrial Equipment, Limited.

MR. A. J. ROUND has been appointed a director of Banks & Davis, coppersmiths' non-ferrous founders, etc., of Deritend, Birmingham.

MR. S. C. JOSEPH, managing director, has been appointed deputy chairman of Clifford Motor Components, Limited, Birmingham.

MR. A. L. MAKINSON has resigned his directorship of Harris, McGregor & Guest, Limited, agricultural engineers, etc., of Leigh, Lancs.

MR. P. A. SMITH has retired from the board of Drake & Gorham, Limited, manufacturing electrical engineers, etc., of London, N.W.10.

MR. A. B. ALLISON, ironworks manager of the Shotts Iron Company, Limited, has retired after being associated with the company for 30 years.

SIR JOHN S. BUCHANAN has joined the board of Dualloys, Limited (a wholly-owned subsidiary of Sterling Industries, Limited, Dagenham, Essex), non-ferrous metal and bearing manufacturers, of Croydon.

MR. A. TORKINGTON, head of the engineering department at Wednesbury County Technical College, has been appointed principal of Stafford County Technical College. He succeeds DR. W. A. J. CHAPMAN in that position.

MR. D. J. W. ORR, MR. G. R. DANIEL, MR. D. KIRKWOOD, JUNR., and MR. L. E. OLDRIDGE have been appointed directors of the National Smelting Company, Limited, a subsidiary of the Imperial Smelting Corporation, Limited.

MR. WILLIAM POSTGATE, secretary of Blackett, Hutton & Company, Limited, steelfounders and engineers, of Guisborough, Yorks, has retired after over 50 years' service with the company. MR. W. M. WILSON has been appointed secretary in his place.

LORD MCGOWAN, chairman of Imperial Chemical Industries, Limited, is to be the first patron of the Purchasing Officers Association, which now has a membership of 1,750 purchasing officers in all branches of industry and public administration.

MR. H. R. HUMPHREYS, deputy general manager of Harland & Wolff, Limited, has been appointed general manager, repair works (London, Liverpool, and Southampton), with headquarters at the company's London office, 9, Whitehall, S.W.1.

MR. JAMES A. RICHMOND has been appointed assistant manager of the Warrington rolling and extrusion mills of the British Aluminium Company, Limited. He was formerly assistant manager of the company's rolling mills at Milton, Stoke-on-Trent.

MR. F. USHER-SMITH and MR. R. M. HYSLOP have been appointed managing directors of Bayliss, Jones & Bayliss, Limited, iron and steel rollers, ironfounders, etc., of Wolverhampton, following the retirement of MR. P. S. BAYLISS and MR. F. W. BAYLISS.

SIR J. FREDERICK HEATON (chairman), LORD HACKING and MR. R. M. MATHESON have resigned from the board of the Bristol Tramways & Carriage Company, Limited. MR. GEORGE CARDWELL has been elected a director and appointed chairman of the company.

MR. G. C. H. MATTHEY has been presented with his portrait in oils to mark the occasion of his retirement from the executive committee of directors of Johnson, Matthey & Company, Limited, precious metal smelters, refiners and engineers, of Hatton Garden, London, E.C.1.

MR. JOHN WILLIAM GARDNER, who for 13 years has been welfare supervisor of the associated Sunderland companies of Joseph L. Thompson & Sons, Limited, shipbuilders, Sir James Laing & Sons, Limited, shipbuilders, and the Sunderland Forge & Engineering Company, Limited, has been appointed Dock Welfare Officer of the National Dock Labour Board, Bristol.

MR. GEORGE CLARK, chairman and managing director of the Bryan Donkin Company, Limited, engineers, ironfounders, etc., of Chesterfield, was entertained at luncheon by his fellow directors and senior members of the staff on January 4 in honour of his 88th birthday. Mr. Clark, who has been managing director of the company for 41 years, was presented with his portrait in oils.

DR. J. E. HURST, of Lichfield, has been appointed to fill the late Mr. G. T. Lunt's positions as follows:—Managing director of Bradley & Foster, Limited, Bradleys (Concrete), Limited, and Bradleys (Darlaston), Limited, and chairman and managing director of Arblaster & Company, Limited, and Ernest Graham & Company, Limited. Dr. Hurst's vacancy on the board of the above-mentioned companies has been filled as follows:—MR. SIMON NEVILLE TURNER is appointed a director of Bradley & Foster, Limited, Bradleys (Concrete), Limited, and Bradleys (Darlaston), Limited; MR. G. E. LUNT (son of the late managing director) is appointed a director of Arblaster & Company, and Ernest Graham & Company.

MR. J. F. PERRY has been appointed managing director and MR. F. J. E. TEARLE general manager of the Metropolitan-Vickers Electrical Export Company, Limited. Mr. Perry joined the then British Westinghouse Company in 1913. He rendered valuable service to the French Reconstruction Committee in replanning the devastated collieries in the north of France after the first world war, and he has since travelled extensively in Australia, Africa and Europe in connection with Metropolitan-Vickers' mining interests. He became sales manager of the plant department in 1935 and 10 years later he relinquished this position to become general manager of the Export Company, of which he had been made a director in the previous year. Mr. Tearle went to Russia on erection work in 1925 and joined the Export Company the following year. He continued to work in Russia, with one interval, till 1933, and during his last three years there he was manager of the Leningrad office. In the last war Mr. Tearle saw naval service, but was recalled from the Middle East at the end of 1942 to take charge of some special contracts. In 1944 he was appointed principal representative of the Export Company at the Trafford Park Works, and a year later he joined that company's board. Since March, 1947, he has acted as special assistant to the Metropolitan-Vickers' management.

Industry and the Profits Tax

F.B.I. Memorandum

During the passage of the Finance Bill last year, attention was called to the fact that profits tax, apart from other objections, falls on the ordinary shareholder, and this may have a distorting effect on the finance of companies. The Chancellor of the Exchequer undertook to reconsider the tax from this point of view before the Budget of 1949. As a result, the Federation of British Industries was requested to submit its views and a memorandum has been submitted. A covering letter explains that the Federation has always been opposed to the whole idea of profits tax, and the fact that the F.B.I. is now making detailed criticisms must not be taken as in any way indicating that its attitude to the tax in general has weakened.

The memorandum points out that the burden of profits tax falls solely on the ordinary shareholder, who has to bear, in addition to his own share, the preference shareholders' share. It singles out corporate income for taxation and it cannot be passed on in the same manner as income tax, thus constituting a burden on corporate savings. Furthermore, the tax encourages the financing of companies by debentures, income notes, or loans from banks or institutions, interest on which is regarded for tax purposes as an expense. The drift towards financing by borrowing is harmful, because it exposes businesses to failure at times of adverse trading experience.

The memorandum also examines the idea of a ceiling to the effective rate of profits tax which would mitigate the severity of the tax on the ordinary shareholder where there are preference shares. The situation is complicated by the fact that the ratio of fixed preference dividends to ordinary dividends varies greatly among companies. The following alternatives have been submitted in order of priority:

(1) To abolish the profits tax completely and to restrict the tax on corporate earnings to the general income tax.

(2) To restrict the profits tax to a distribution tax on ordinary and participating non-cumulative preference dividends.

(3) To restrict the profits tax to distributions and to give an option to the Crown either to levy the general distribution rate on equity dividends as included above, that is, 25 per cent. or such lower rate as may be fixed, or, alternatively, to levy at a lower rate, say, 10 per cent. on the sum of the equity dividend and the fixed preference dividends. The option would operate where the preference dividends are one-and-a-half times as much as the ordinary dividend.

W. H. ALLEN, SONS & COMPANY, LIMITED, Bedford, and the Bristol Aeroplane Company, Limited, are to collaborate on the application of gas turbines for marine auxiliary purposes and in the industrial field, and in the exchange of information on aeronautical and industrial turbine problems.

Contracts Open

The dates given are the latest on which tenders will be accepted. The addresses are those from which forms of tender may be obtained.

ABERTILLERY, January 31—Supply of 2,615 yds. of 4-in., 333 yds. of 6-in. and 340 yds. of 8-in. dia. mild-steel tubes with sleeve joints for welding, for the Urban District Council. Mr. D. S. Davies, engineer and manager, Gas Offices, Abertillery.

BEDFORD, January 31—Founders' work, for the Borough Council. Mr. C. H. Blakeway, borough engineer and surveyor, Newnham House, Horne Lane, Bedford.

BIRKENHEAD, January 28—Rivets, bolts, nails, iron, steel, iron castings, rolled zinc boiler plates, etc., for the Corporation. The Birkenhead Corporation Ferries General Manager, Woodside Ferry, Birkenhead.

BOOTLE, January 29—Cast-iron manhole covers and gully grates (Ref. No. 6), nails, rivets, screws, bolts, etc. (17 and 18), for the Corporation. The Borough Engineer and Surveyor, Town Hall, Bootle.

CARMARTHEN, February 9—Supplying and laying of spun-iron water mains, for the Rural District Council. Mr. G. G. Thomas, engineer to the Council, 3, Spilman Street, Carmarthen. (Fee £7 7s., returnable.)

CROMPTON, February 9—Supply of iron castings, etc., for the Urban District Council. Mr. J. E. Gledhill, engineer and surveyor, Town Hall, Shaw, near Oldham.

HAYES, February 2—Supply of cast manhole covers and road gully gratings and frames, for the Urban District Council. The Engineer and Surveyor, Town Hall, Hayes.

LEEDS, February 3—Street nameplates, road plates and studs (steel), etc., for the City Council. Mr. L. R. Moir, highways engineer, 155, Kirkstall Road, Leeds, 4.

LONDON, S.E., February 16—Drain pipes, sewer ironwork, iron, etc., for the Metropolitan Borough of Southwark. Mr. D. T. Griffiths, town clerk, Town Hall, Walworth Road, London, S.E.17.

MANCHESTER, January 29—Supply of 1,000 yds. of 1½-in., 1,000 yds. of 2-in., 20,000 yds. of 4-in., 4,000 yds. of 8-in., 800 yds. of 10-in., and 5,000 yds. of 12-in. socket and spigot water pipes (equal to B.S.S. Class "C" Schedule for cast-iron pipes) and 2,500 streamlined valve hydrants, for the Corporation Waterworks. The Secretary, Waterworks Offices, Town Hall, Manchester, 2.

NEWPORT, MON., January 29—Traffic signs, for the County Council. Mr. R. Cornish, county engineer and surveyor, "Stelvio," Bassaleg Road, Newport, Mon.

SOUTH KESTEVEN, February 2—Supply and laying of approx. 1,782 yds. of 4-in. spun-iron water main, for the Rural District Council. Mr. A. H. Harvey, water engineer, Council Offices, 41, North Street, Bourne, Lincs. (Deposit £2 2s.)

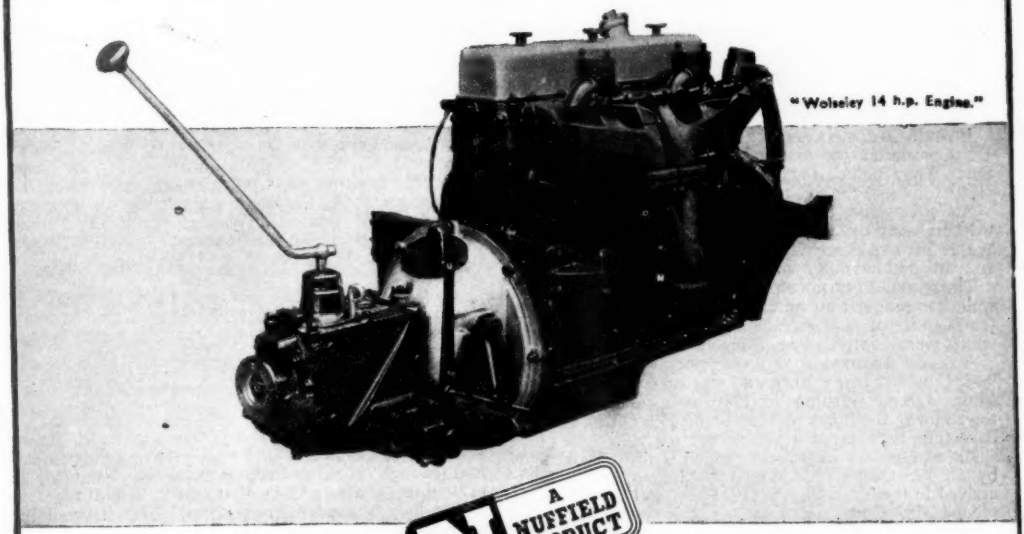
SOUTHEND-ON-SEA, February 5—Iron castings, etc., for the Corporation. The Borough Engineer, Southend-on-Sea.

STAFFORD, February 4—Traffic signs, castings and road ironwork, plant, etc., for the County Council. Mr. R. S. Murt, county surveyor, County Buildings, Stafford.

STEVENAGE, February 9—Supply of cast-iron manhole covers and frames, etc., for the Urban District Council. Mr. J. D. Marshall, engineer and surveyor, Council Offices, Stevenage, Herts.

MR. REX BATE has been appointed a local director of the Brush Electrical Engineering Company, Limited, with the title of sales director.

IMPORTS OF iron and steel and manufactures (excluding cutlery and machinery) into Eire last November were valued at £518,866, against £483,902 in November, 1947. The total value for the first 11 months of 1948 was £5,897,051, against £4,390,786 in 1947. Among the imports in November were:—Pig-iron, 111 tons, valued at £3,501, against nil in November, 1947; iron bars and rods, 43 tons (£1,324), against 228 tons (£8,769); steel bars and rods, 737 tons (£24,020), against 784 tons (£22,186); iron and steel squares and flats, 577 tons (£20,484), against 476 tons (£18,109).



"Wolseley 14 h.p. Engine."

A NUFFIELD PRODUCT

Using

STANTON-DALE

REFINED PIG IRON

USED AND RECOMMENDED
FOR ALL HIGH-DUTY
ENGINEERING CASTINGS

THE STANTON IRONWORKS COMPANY LIMITED, Nr. NOTTINGHAM

News in Brief

J. BROCKHOUSE & COMPANY, LIMITED, spring and axle manufacturers, of West Bromwich, has acquired the business of Kaye Alloy Castings, Limited, Birmingham.

CONSEQUENT ON an increase in the cost of living, the joint industrial council for the lock, latch and key industry has announced an increase of 5 per cent. on basic wages rates.

INTERIM ALLOCATIONS of tin metal by the Combined Tin Committee for the first half of 1949 total 28,740 tons. They include 19,000 tons to the United States and 4,540 tons to France.

AN AGREEMENT has been reached on behalf of steelworkers employed at works belonging to the South Wales Siemens Steel Association to give a year's trial to an extended working week.

THE STEEL CONSTRUCTION COMPANY, LIMITED, Motherwell, has received an order for five crane structures for the purpose of reconstructing the docks at Hong Kong, which were badly damaged during the war.

A LARGE ADMIRALTY FLOATING DOCK, which measured 960 ft. by 180 ft. by 70 ft. and was sunk by bombing in Malta Grand Harbour in 1940, has been raised and towed away for breaking up. Some 27,000 tons of steel have thus been made available for scrap.

AN EX-GERMAN DESTROYER, which is to be broken up by C. W. Dorkin & Company, Limited, Sunderland, arrived in the Tyne from Scapa Flow on January 10. A second destroyer, which arrives this week, is to be broken up by J. J. King & Company, Gateshead.

PROBLEMS OF factory planning and construction will be discussed at a conference on industrial building at the Royal Institute of British Architects on March 3 and 4. Industrialists interested are invited to attend the conference, admission to which will be by ticket only. Further particulars may be obtained from the Secretary, Royal Institute of British Architects, 66, Portland Place, London, W.1.

THE DIRECTORS OF Fletcher, Houston & Company, Limited, ironfounders and engineers, of Tipton, South Staffs, announce that a conditional agreement has been entered into by the company for the acquisition of the whole of the issued capital of Carlton Motor Stampings, Limited, Dudley Port, Staffs. The purchase consideration for the acquisition of the Carlton company is £88,750, to be satisfied as to £43,750 by the allotment to the vendors at a price of 3s. 6d. per share of 250,000 ordinary shares of 1s. each and as to the balance of £45,000 by payment in cash out of the company's existing resources.

AN ORDER has been placed with the Wellman Smith Owen Engineering Corporation, Limited, by John Summers & Sons, Limited, Shotton, Chester, for two 250-ton and two 125-ton, heavy-duty ladle cranes, 78-ft. span, for Summers's new steel plant. The 250-ton cranes will operate in the casting bay and the 125-ton cranes in the furnace bay. Among the cranes recently constructed by the Wellman Corporation is an electric overhead travelling crane, with a rated lifting capacity of 350 tons, but designed for occasional loads up to 400 tons This is understood to be the largest electric overhead travelling crane in Europe, if not in the world.

Regional Boards for Industry

As Regional Boards for Industry appointments, which were for a period of three years, have now expired, the Chancellor of the Exchequer has accordingly made the following reappointments and filled vacancies which have arisen through retirements on account of ill-health or pressure of other work.

NORTHERN: Sir Mark Hodgson *vice* Viscount Ridley; EAST AND WEST RIDINGS: Mr. G. H. Bagnall; NORTH MIDLAND: Mr. S. F. Peshall; EASTERN: Mr. H. Weston Howard; LONDON AND SOUTH-EASTERN: Sir John Buchanan *vice* Sir Frederick Leggett; SOUTH-WESTERN: Lt.-Col. Mark Whitwell; WALES: Sir Percy Thomas; MIDLANDS: Mr. W. H. Stokes; NORTH-WESTERN: Major J. H. Mandleberg; and SCOTLAND: Bailie C. Murdoch.

An appointment has not yet been made for the Southern Region *vice* Mr. C. N. Gallie, who is unable to accept reappointment as chairman for health reasons.

Shipbuilding Uncertainties

Mr. F. O. John, a director of Cammell Laird & Company, Limited, the shipbuilders, told Birkenhead Chamber of Commerce on January 11 that the company had enough work to keep it fully employed for the next three years. After that work would taper off unless they booked further orders. This it was hoped to do shortly, but the future was uncertain. If freights kept up shipowners would require further tonnage, but if prices continued to rise owners would be very chary about placing orders except at fixed prices, and shipbuilders would be equally chary about giving fixed prices. The steel industry was another unknown factor. If, after nationalisation, it followed coal, with the price up and the quality down, or even followed electricity with a rise in price, the shipbuilding industry and every other industry would suffer.

Changes of Name

The following companies have recently changed their names, the new titles being given in parentheses:—

METAL COATING, LIMITED, Lowestoft (Metal Coating (Motors), Limited).

BLASEBALK ENGINEERING, LIMITED, Islington, London, N.1 (Spandor Engineering, Limited).

UNION METALS, LIMITED, Coventry (Greyfriars Foundry & Engineering Company, Limited).

ACE WELDING SHEET METAL & BOILER COMPANY, LIMITED, London, E.C.2 (Ace Autos, Limited).

KIRBY SIMMONS, LIMITED, patternmakers, founders, casters, etc., of Coventry (Simmons (Patternmakers), Limited).

EUTECTIC WELDING ALLOYS CORPORATION, LIMITED, London, E.C.2 (Eutectic Welding Alloys Company, Limited).

BEATON HEAT TREATMENTS, LIMITED (formerly E-H Fuel Injection, Limited), Brentford, Middx (Albion Twist Drill & Tool Company, Limited).

MR. D. MACBETH has relinquished his position with the Morgan Crucible Company, Limited, after 23 years' service, to take up an appointment with T. J. Priestman, Limited, Birmingham.